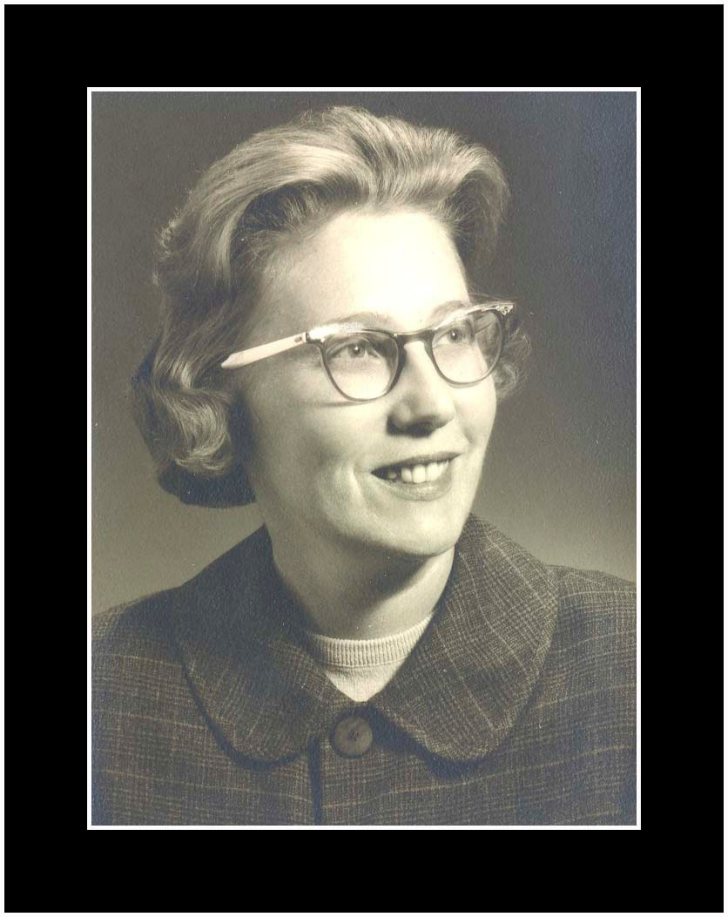
AN EXPERIMENT TO DETERMINE THE EFFECTIVENESS OF TRANSLATING WORD PROBLEMS INTO EQUATIONS IN TEACHING PROBLEM-SOLVING TO SEVENTH GRADE STUDENTS

by Betty Lou Stevenson

(Research study conducted in cooperation with the Whittier College Department of Education—January 5, 1969.)



Betty Lou Stevenson

The Problem. The problem investigated was whether translating word problems into sentences—i.e., equations—would significantly affect problem-solving by seventh grade students.

The Design. The design involved teaching problem-solving to two average seventh grade math classes over a three-day period. Both groups reviewed questions that might be used to analyze a word problem, and practiced solving story problems with oral and written activity. However, Group 1, the experimental group, was drilled on translating English sentences into arithmetic sentences and writing equations; this group translated all word problems into equations, and then solved the equation in order to answer the problem. Group 2 did not work with equations. A posttest only was given, and the mean scores were compared to the *t* test.

PROCEDURES

The Subjects. The subjects in the experiment were seventh grade students of average ability, ranging in age from eleven to fourteen years—a total of twenty-seven (fourteen girls, thirteen boys) in each group.

Seventh grade students have been grouped homogeneously in math classes at Wilshire Junior High School, Fullerton, California. Criteria for placement in Basic Mathematics are: Arithmetic Scores—74th to 25th percentile; Reading Score—85th to 25th percentile; and IQ—114 to 90.

Selection. The subjects were members of two basic mathematics classes, periods 6 and 7, taught by the experimenter.

Materials Used in the Experiment. Materials used for the experiments were from the California Basic Mathematics textbook, *Mathematics 7*, by McSwain, Brown, Gundlach and Cooke, and the workbook *Practice for Mathematics 7*, by the same authors. The text offered a variety of problems for oral and written work (pages 48-51). Some of the oral exercises were designed so that the student need not be concerned with particular numbers; instead, these exercises were focused on directing the student's attention to the basic relationship and operations required for the solution of the problem. A ditto sheet containing simple word problems based on workbook material was a class exercise.

The Treatment. The first day lesson covered the following questions and activities: "What are you asked to find in the problem? What information is given? What information is necessary in order to solve the problem? What operation or operations could be used? What are the clues as to which operation?" These questions were applied to three oral problems from the text after each problem was read by individual students; volunteers solved problems on the board.

"Knowing what you are to find and which operation, or operations, to use are helpful only if you can translate the problem into a number sentence." This instructional statement introduced the study of examples of English sentences being changed into number sentences, then oral practice in translating text sentences into equations, and finally a written assignment—writing an arithmetic sentence for each English sentence, with the challenge to translate four equations into English sentences.

The second day lesson began with a review of translating sentences, rereading the English sentences, and then providing the

number sentence answers on written assignment. Those problems which caused difficulty were put on the board and discussed. Students volunteered imaginative sentences for given equations. The basic steps of problem-solving were listed on the board: "Read the problem carefully. Translate problem into an arithmetic sentence. Solve the equation in order to answer the problem." A ditto sheet containing simple word problems was distributed. Students took turns reading the short story problems and putting the equation for solving each on the board. Class solved the equations in order to answer the problems.

On the third day the basic steps of problem-solving were again listed on the board. Three example problems from the text were studied—read aloud, discussed, equation written, and problem solved on the board.

The Posttest. The evaluation of instruction took place on the third day. Of the twenty-seven students beginning the experiment, twenty-five took the test; one student dropped out of the control group. Approximately thirty minutes were allowed for the test; all subjects completed it, but in varying times. The objective test was given by the experimenter with the following oral instruction: "If you need any help with the words, please see me."(A reminder was given to the experimental group only, Group 1: "Write an equation before solving each problem.")

ANALYSIS AND RESULTS

Type of Analysis. A statistical analysis was made, including the frequency distribution, the measures of central tendency and variability.

Results of Test Analysis. The Means, Standard Deviations, and N's are shown in Table 1.

Table 1. Means and Standard Deviations in Experimental Design

	Mean	**Standard Deviation**	**N**
Group 1 (Experimental)	63.6	22.42	25
Group 2 (Control)	69.6	23.13	26

The frequency distribution of arithmetic scores is illustrated in Table 2. The statistics presented below produced additional information:

	Group 1 (Experimental)	Group 2 (Control)
Range	90	70
Mode	80	80
Median	63.5	71.92

Table 2. Frequency Distribution of Arithmetic Scores

Score Interval	Group 1 Frequency	Group 2 Frequency
90 - 100	2	4
81 - 90	1	3
71 - 80	6	7
61 - 70	5	3
51 - 60	2	1
41 - 50	5	2
31 - 40	1	3
21 - 30	1	3
11 - 20	1	0
1 - 10	1	0
	25	26

CONCLUSIONS

The scores indicated that translating word problems into equations did not significantly affect problem-solving by seventh grade students of average ability—certainly not in a positive way. Factors which may have influenced the outcome include the history of the three-day period and maturation processes (such as

more fatigue and less interest than the control group); the experimental group did, in fact, meet right after lunch. The particular type of subject who dropped out of each group may have affected the findings of the investigation—a mortality loss of two from Group 1 and one from Group 2.

A pretest was not used, which would have been an added check on the sameness of the groups. In calculating the significance of the difference between the means, the value of *t* (7.317) was greater than the .01 level of probability for 49 degrees of freedom, indicating that there was a real, and not a chance, difference between the group means.

The success of the experiment rested on the assumption that the experimental and control groups were equivalent in respect to all factors that might influence the dependent variable, except for the exposure to *X*. The experimenter had tried to eliminate any possible differences in reading ability by means of emphasis on the oral and assistance with vocabulary. Because of the *t* test results, the experimenter checked the subjects' reading and arithmetic scores on the California Achievement Tests given in October, 1968, with the following picture presenting itself:

	Reading Mean	**Arithmetic Mean**
Group 1 (Experimental)	51.2	49.2
Group 2 (Control)	55.73	61.3

This differential selection of subjects would account for the test results. The mean difference of +6 on the design test in favor of the control group corresponded to the +12.1 on the arithmetic ability mean. Therefore no conclusion on the effectiveness of teaching problem-solving to seventh grade students by translating word problems into equations is valid.

BIBLIOGRAPHY

Good, Carter V., and Douglas E. Scates, *Methods of Research*. New York: Appleton-Century-Crofts, Inc., 1954.

Koenker, Robert H., *Simplified Statistics*. Bloomington, Illinois: McKnight & McKnight Publishing Company, 1961.

Thorndike, Robert L., and Elizabeth Hagen, *Measurement and Evaluation in Psychology and Education*. Second Edition, New York: John Wiley & Sons, Inc., 1961.

Name _____
Class _____

TEST (12/5/68)

Answer the question asked in each problem. Show all work.

1. Closest distance of the moon from Earth: 221,463 miles. Farthest distance: 252,710 miles. How much change in distance?

2. A plane flew 2,275 miles in 7 hours. What was its average speed?

3. Mary bought a sweater for $8.95 and a skirt for $12.98. What was the total cost of her new clothes?

4. Joe had $127.05 in the bank. He wrote a check for $33.95. How much did he have left in the bank?

5. Dennis and his father drove 423 miles on the first day of their trip, 386 miles on the second, and 308 miles on the third. How far did they drive in three days?

6. A car averages 18 miles per gallon of gasoline. How much gasoline is needed to drive the car 594 miles?

7. An appliance store sold 37 automatic washers for $253.00 each. What was the total cost of all 37 washers?

8. Jim scored 13, 19, and 25 points in 3 basketball games. What was his average score?

9. The Mackinac Bridge has a center span of 3800 feet and two end spans of 1800 feet each. What is the total length of the bridge?

10. Jerry read six 21-page chapters in a book and still had 246 pages to read. How many pages did the book contain?